Bill,

Thank you for the opportunity to review your report to the EPA. I am attaching my detailed comments in a separate PDF. Your rejoinder about Colorado having the largest "documented" injection-induced earthquake is characteristic of much of the attitude that I have heard from the USGS on the Raton Basin earthquake activity.

I find it of more than passing interest that the recently-released, National Research Council Report on induced seismicity made no mention of the Trinidad earthquakes being induced. Yet, they were fully aware of the events because they cited the steps that the Colorado Oil and Gas Conservation Commission and the Colorado Geological Survey have taken to review all new Class II UIC wells for potential, induced seismicity. NRC's Figure S.1 which is captioned in part as, "Sites in the United States and Canada with documented reports of seismicity caused by or likely related to energy development from various energy technologies", shows four sites in Colorado, and sites in twelve other states including Texas, Arkansas, Oklahoma, and Ohio. ***The Raton Basin is notably absent.***

In general, I would say that T. C. Chamberlain's Method of Multiple Working Hypotheses is absent from this research. The single assumption of these USGS researchers that the earthquakes are obviously induced, extends right down to the changing of the Davis and Frohlich questions.

Vince

COLORADO GEOLOGICAL SURVEY REVIEW OF "Evaluate Potential Risks of Seismic Events Due to Injection-Well Activities – Part 2" by A. McGarr, W. Ellsworth, J. Rubinstein, S. Hickman, E. Roeloffs, C. Williams, and D. Oppenheimer

Introduction

This review was conducted primarily by Dr. Vince Matthews, State Geologist of Colorado, with input from Dr. Paul Morgan, the Colorado Geological Survey's geophysical and geothermal expert who has published extensively on the Rio Grande Rift and studied the geothermal potential of the Raton Basin.. In this review, the particular section of the McGarr, and others report that is being commented on will be referenced with "REPORT". The Section numbers will be designated as "S1.0", page numbers designated as "P2", paragraph numbers designated as "pp3", Table numbers T2, and Figure number as "F6" . That will be followed by "COMMENT" for each quoted REPORT section.

Review Comments

REPORT S1.0, P2, pp2: "Three lines of evidence indicate that these earthquakes were induced: (1) there was a large, statistically significant increase in seismicity beneath the portion of the Raton Basin where wastewater was being injected following the commencement of fluid injection; (2) the seismicity in the region since 2001 is located close to high-volume fluid-injection wells; (3) both the 2001 and 2011 earthquake sequences occurred at shallow depth beneath high-volume disposal wells."

> **COMMENT**: (1) The multinomial test applied on page 25 of the report is not a valid statistical test for a system that is randomly distributed in time.
>
> (2) Figure 5 of the report belies this claim by showing a diffuse pattern of epicenters with no apparent clustering with injection wells.
>
> (3) Earthquakes throughout much of the Raton Basin extend down to ten kilometers, but this is still being refined by careful, well-controlled data collection and analysis. The 2001 and 2011 events are indeed shallower, but the report fails to discuss the correlation of these events with a strong heat flow and geothermal-gradient anomaly directly beneath them that has been studied for potential EGS exploitation by industry and the Colorado Geological Survey.

REPORT S1.0, P2-3, pp4: "The reluctance of *Meremonte et al.* (2002) to decide whether the earthquakes were natural or induced was based in part on their answers to a set of questions proposed by *Davis and Frohlich* (1993). We revisited those questions and the corresponding answers given by *Meremonte et al.* (2002) in the light of experience and earthquakes that occurred over the succeeding ten years and find that answers to some questions would now be different."

> **COMMENT**: The answers are different because the authors of this report chose to *change the questions*. Meremonte and others (2002), as well as Matthews (2002), were being scientifically responsible by following established protocols and not pushing an agenda.

REPORT S1.0, P3, pp2: "Relocations of the earthquakes comprising the 2001 sequence indicate slightly shallower depths than reported by *Meremonte et al. (2002)*, but confirmed the northeast alignment of the earthquakes whose locations define a plane dipping steeply toward the southeast. Our recent analysis also confirmed that these epicenters are centered on the Wild Boar disposal well."

> **COMMENT**: There is nothing new here. The map, cross-section, and moment tensor solution by *Meremonte et al. (2002)*, all show that there is a normal fault striking northeast-southwest and dipping to the southeast, centered on the Wild Boar well. Moreover, CGS mapped a fault where the seismic activity projects to the surface, conducted a trend-surface analysis of the surface topography, and interpreted seismic lines shot by the oil and gas industry; all of which documented a normal fault with approximately 100 m of displacement dipping to the southeast coincident with, and consistent with, the seismic activity.

REPORT S1.0, P3, pp6: "Statistical analysis of the earthquake activity near Trinidad before and after mid-2001 shows that the increase in earthquake rate starting in August 2001 cannot be produced by a natural fluctuation in earthquake rate."

> **COMMENT**: During a six-month period in 2001-2002, three earthquakes M≥ 4.0 struck Colorado in widely scattered areas. I am not aware of any other six-month period in the previous 134 years that has a similar record. This illustrates the problem with the application of the multinomial test because it assumes predictable probability distributions for the earthquakes in time. If earthquakes are random (as assumed in the report) then they do not have a predictable probability distribution. Therefore the test is invalid.

REPORT S3.1, P6, pp3: "Meremonte et al. (2002) noted, however, that if the sequence of 2001 was natural, then they would expect the seismicity to subside generally with time, whereas, if induced, then the earthquake activity would continue as long as there are injection activities there. The continued elevated seismicity in the succeeding 10 years can be taken as evidence favoring the conclusion that these earthquakes are induced."

> **COMMENT**: The earthquake activity did indeed decrease with time on this fault, even though injection volumes in the Wild Boar well did not fall below 150,000 barrels per month until 2004. This is not typical of faults with induced seismicity. Faults with induced seismicity generally show a correlation of earthquake frequency with volumes of injection. Moreover, Art Frankel (personal communication, 2002)) expressed concern that if the earthquakes were natural, then the fault might be capable of generating a magnitude 5.8 earthquake (Matthews, 2002). It is therefore of interest that the August 2011 event was an M 5.3, on possibly the same northeast-southwest-trending fault.

REPORT S3.2, P6, pp5: "Many of the earthquake sequences that are now accepted as induced occurred in regions that had been aseismic during the past century or two; thus, their occurrence in regions previously considered aseismic was the first indication that they represented non-natural phenomena."

> **COMMENT**: The very first question by Davis and Frohlich (1993) is important because the presence of previous earthquake activity was significant to them in determining whether earthquakes were induced, or not. The authors of this report try to downplay the importance of this question.
>
> The Trinidad area has a history of natural earthquakes (Kirkham and others, 2012):
>
> - In 1966, a 4.5 magnitude earthquake was reported northeast of Trinidad.
> - In 1973, a swarm of four earthquakes ≤4.2 magnitude was reported west of Trinidad, decades before water injection began.
> - In 1983, a magnitude 3.2 earthquake was reported northeast of Trinidad.
> - In 1996, a series of three earthquakes ≥3.2 magnitude hit northeast of Trinidad.
>
> Moreover, long-time residents in the Segundo area near the epicenter of the 2001 event reported that the shaking and damage from the 1973 earthquake was essentially the same as

the 2001 event. This strongly suggests that the 1973 event was on the same fault as the 2001 event.

After the pre-2001 events, local arrays were not installed to collect aftershock data. We have no information to determine whether the post-2001 events are of a different character to earlier events in terms of distribution in space, and perhaps even time.

REPORT S3.2, P7, pp3: "Before August 2001, when the earthquakes in the Raton Basin composing the sequence began to be noticed, the regional seismic station coverage was sparse, and the magnitude threshold for earthquake detection was probably no better than M2.5. Moreover, population density in the vicinity of the Raton Basin injection wells is much lower than in Youngstown. Thus, the observed delay between April 2000, when injection started at the Wild Boar well, and August 2001, when the earthquakes began to be felt, should not be construed as evidence that these earthquakes were natural. There are at least several possible factors that might cause delays between injection activities and the resulting earthquakes, including the effects of detection threshold, just discussed. Also, as discussed more below, faults that are amenable to seismic failure in response to an imposed fluid pressure change may lie at some distance from the injection well. Thus, it may take some time for fluid pressures from an injection well to diffuse to the point at which an earthquake might be induced."

COMMENT: The threshold detection ofM2.5 pre-2001 is probably optimistic from stations that are 340 km from the earthquakes. The threshold would depend on depth, fault orientation, and noise levels at the relevant recording stations.

Earlier, the authors make a point that the earthquake swarm is centered on the Wild Boar well. Now, they are trying to argue that the fault lies at some distance to the well, in order to explain a phenomenon that Meremonte, et al (2002) recognized in answering this question. I don't see how it can be both ways.

REPORT S3.2, P7, pp5: "For these reasons, we favor revising Question 2 to: —Is the occurrence of earthquakes consistent with the injection time history in a physically plausible way?□"

COMMENT: Since there is no data to change Meremonte's 2002 answer to Question 2 from no to yes, the authors of this report ***change the question*** in order to change the answer from no to yes! This raises the serious question of impartiality in this report.

REPORT S3.2, P8, pp2: A suitably-revised version of Question 3a might be: —Are the locations of epicenters consistent with possible fluid flow from the injection interval to the hypocenters?

COMMENT: In Mermonte et al's (2002) study the answer was yes because the majority of the recorded earthquakes were in the vicinity of the well. In this study, however, the majority of the earthquakes are not in the vicinity of an injection well. Long flow paths would need to be proposed to connect these earthquakes to an injection well. In the discussion of question 3c, the authors suggest that prediction of long flow paths is not objective. The discussion of question 3c negates the modification of this question. The answer must be for some earthquakes yes, for many, no.

REPORT S3.2, P9, pp2: "We suggest revising Question 3b to: —Are the depths of the earthquakes relative to the injection interval consistent with the flow of liquid through high permeability conduits?"

> **COMMENT**: As with question 3a, a firm yes answer relies on definitive knowledge of the subsurface of "high permeability conduits," which are required to connect injection wells to many earthquakes over considerable distances (>10 km). This knowledge is considered speculative (non-objective) in question 3c. The answer to the original question is some yes, many no. The answer to the modified question is some yes, many speculative.

REPORT S3.2, P9, pp4: Accordingly, we advocate discarding this question on the basis that responses to it are likely to be less than objective because permeability in the Earth's crust is often highly heterogeneous and information on the distribution and hydraulic properties of potential deep conduits for fluid flow are rarely known.

> **COMMENT**: Hydrogeology and fluid flow in the Raton Basin has been the subject of many studies. It is surprising that no use of this work has been made. In our opinion, relevant information is: 1) upper "perched" water table from coalbed methane water is withdrawn; 2) lower water table into which injection occurs; 3) general basin structure with strong layering at all scales; 4) slow water flow from west toward Purgatoire drainage (deduced from piezometric gradient and thermal gradients in upper and lower water tables).
>
> Many earthquakes occur away from the wells. If we accept your reasoning to discard the question, what do we do with these earthquakes? They are a majority of the events and must be explained.

REPORT S4.1, P11, pp2: On a regional basis, it is unlikely that an earthquake of M4 or larger would have escaped notice after 1963.

> **COMMENT**: The focus on proving that the Trinidad earthquakes were induced has apparently blinded the researchers to other possible explanations for the earthquakes. For instance, the 2011 M 5.3 event is only 70 km from the east side of the Rio Grande Rift. In 1966, a 5.5 M earthquake and swarm was recorded near Edith, Colorado only 75 km from the west side of the rift. Trenching by the USGS Hazards Mapping team revealed Holocene faulting only 52 km west of the epicenter of the magnitude 5.3 event. Except for the brief mention and dismissal of Rio Grande Rift strain rates, the researchers have ignored the fact that the Raton Basin is a part of a major rift system that cuts across central Colorado.
>
> - The researchers did not mention, nor investigate, the potential relationship of these earthquakes to the strong geothermal anomaly under the 2001 and 2011 events.
> - The researchers did not address the earthquake clusters that are not near injection wells.

- The researchers did not compare these Raton Basin events to other swarms in Colorado such as the 12 recorded events near Edith, the 17 events near Carbondale in 1984, the 19 events northwest of Crested Butte in 1986, or the 14 events near Creede in 1928.
- The researchers did not consider the correlation of earthquake activity with precipitation variability in the basin, e.g. there is a very general correlation between low precipitation and increased seismicity.
- The researchers did not consider the impact that precipitation in the recharge area of this under-pressured basin that is open on both ends may have on earthquake activity.

REPORT S4.1, P11, pp3: "Due to the wide spacing of seismograph stations, the absolute epicentral location uncertainty is approximately 10 km.**"**

COMMENT: A precision of ten kilometers is significantly lower than most researchers in Colorado would claim. Indeed, Figure 3a shows that the researchers themselves moved the 2001 M4.6 event 17 kilometers in order to put it where they want it (I agree with this placement). Yet, they repeatedly use the 10 kilometer figure throughout the rest of the report.

REPORT S4.4, P14, pp1: "This sequence began on August 28, 2001, with a M3.4 earthquake. The largest earthquakes in the sequence were M4.0 and M4.5 and occurred September 4, 2001, and September 5, 2001, respectively."

COMMENT: The September 5, 2001 event was M4.6, not M4.5.

REPORT S4.4, P14, pp3: "The earthquakes from September 10, 2001 and later (indicated by asterisks, Table 1) were located using the denser local network, and the locations are more precise, ± 0.5 km."

COMMENT: This sentence indicates that the network station density increased in September 2001 which would have increased the sensitivity of the network and the number of earthquakes recorded.

REPORT S4.5, P18, F5: *Map of seismicity in the Raton Basin between November 2001 and July 2011).*

COMMENT: This figure shows diffuse epicenters with no apparent clustering associated with injection wells. This figure raises serious objections that the injection wells are triggering the earthquakes.

REPORT S4.6, P18, pp2: The aftershock sequence was brief, terminating within approximately one month of the mainshock.

COMMENT: The aftershocks did not stop, but continue today.

REPORT S4.6, P20, F6a: *Map of the seismicity in the Raton Basin beginning at the start of the earthquake sequence that began on August 22, 2011, and continuing through December 15, 2011.*

COMMENT: The cluster of events in NM is not associated with an injection well. The cluster of events with N-S trend on the western margin of the basin in Colorado is not associated with an injection well. This figure raises serious objections that the injection wells are triggering the earthquakes.

S4.7, P25, pp1: "Assuming that earthquake occurrence is random (i.e., that the earthquakes are not causally related to one another), we used the multinomial test to determine how likely it is that we would observe 8 earthquakes in a 10.5 year period (August 2001 – December 2011) and only one earthquake in a 31.5 year period (January 1970–July 2001). The multinomial test determines that this is highly unlikely; that is, it has a 0.01% chance of happening randomly."

COMMENT: The multinomial test is a valid statistical test for a system that is randomly distributed in time. The test is whether the observation of one earthquake in a 31.5-year period followed by nine earthquakes in a 10.5-year period have the same probability distribution. The probabilities are given as 0.75 for the pre-2001 period (30.5 years divided by a total of 42 years for the complete study period) and 0.25 for the post 2001 period (10.5 years divided by 42 years). Only one event occurred pre-2001; nine events occurred post-2001. The problem with the application of the multinomial test is that it assumes predictable probability distributions for the earthquakes in time**. If earthquakes are random (as assumed in the report, also see, e.g., www.earthquake.ethz.ch/education/NDK/NDK), then the authors do not have a predictable probability distribution.** Therefore, the test is invalid.

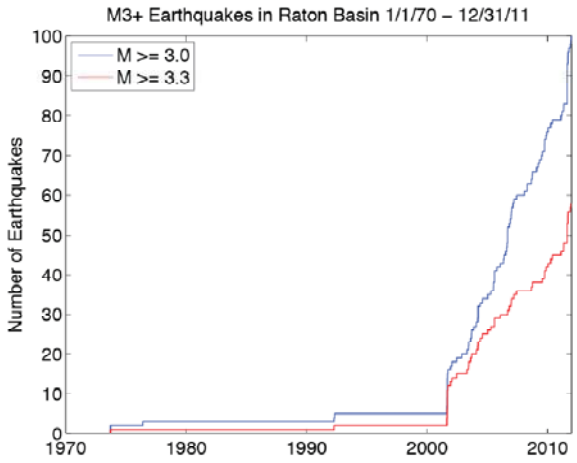
The assumed "predictable probability distribution" is a constant-rate random process on the scale of one year. This may be likened to a coin toss with one coin toss per year. The constant rate is one coin toss per year, the result is a head or tail (50% probability). Each year the result is independent of all previous years - a random process. In the case of the earthquakes there are 9 earthquakes in 42 years. The probability is 9/42, or 21.4%. The multinomial test is the probability that 9 events, with a probability of 21.4%/year, will be distributed so that only one event occurs in the first 31.5 years and the remaining 8 events occur in the last 10.5 years. This probability is very small, 0.01%.

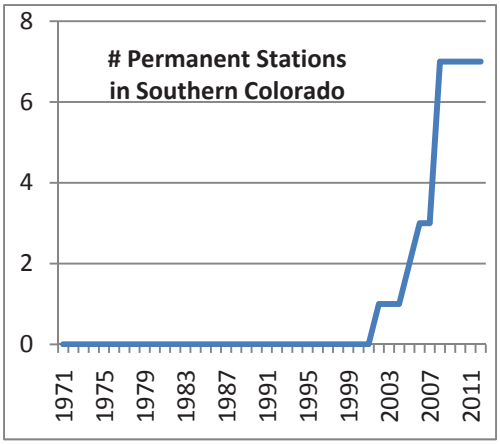
The basic difference between the assumption in this statistical test and in the random temporal distribution of earthquakes in my experiments was that I assumed a constant-rate random distribution with a scale of 39 years (1973-2011). I ran a random-number generator nine times in each experiment to select years for nine earthquakes. Each selection was independent of the previous selection. The probability of any one year being chosen in each selection was 1/39, or 2.6%. If the period is extended to 42 years for direct comparison with the USGS multinomial test, the probability of a particular year being selected from a single random pick is 1/42. or 2.4%. There are nine selections in each experiment and the multinomial test may be used to determine the probability that any one year will result from these nine selections. This probability is 17.7%. Thus, an increase of the scaling period for the constant-rate random process from one year to 42 years decreases the probability that an earthquake will occur on any particular year from 21.4% to 17.7%.

The multinomial test does show that the rates are different pre- and post-2001 on a rate scale of one year. However, as shown in the previous paragraph, the scale-length assumed for rate is significant in earthquake statistics. One year is certainly too small. Fifty years is probably too small for intracontinental earthquakes. One hundred to five hundred years may be a more significant time scale to remove statistical bias. Unfortunately we do not have sufficiently long records of intracontinental seismicity to make strong conclusions from changes in rates of seismicity.

An additional problem in the statistical analysis is that is assumes no temporal bias in the data. If more events were recorded post-2001 because recording sensitivity increased, then the analysis is invalid.

The authors point out that in 2001 the two nearest stations in the NEIC permanent network were 340km from the Raton Basin. Since then, seven permanent stations have been added to the NEIC network between the Idaho Springs station and the Colorado/New Mexico border. The charts below show that the timing of the installation of these additional, permanent stations shows a strong correlation with increased seismicity.





S4.7, P26, T2: "09/05/2001 Magnitude 4.5"

COMMENT: The magnitude of the 09/05/2001 is again incorrect.

S5.1, P27, pp2: The initiation of this earthquake sequence near these two wells suggests that there is a causal relationship between these events and the VPRC wastewater injection activities.

COMMENT: A "suggestion" of causal relationship, is not a scientific basis for a definitive conclusion that the earthquakes are induced. Both USGS and CGS discussed the possibility in 2001 that the "nearness" of the Wild Boar well to the 2001 swarm was suggestive of a causal relationship. However, both groups reviewed the swarm in separate ways,-- the USGS team applying the Davis/Frohlich questions (without arbitrarily changing the questions) and CGS comparing the characteristics of the 2001 events to the characteristics of the Rocky Mountain

Arsenal events. Both teams independently concluded that the data were equivocal as to whether they were induced. In other words, these analyses were led by the data, rather than trying to support a pre-conceived result.

S5.2 P29, pp1: ". . . that we would attribute, at least in part, to the earthquake detection threshold . . ."

COMMENT: This statement corroborates the importance of the change in sensitivity of recording events to the number of events recorded.

S 6.0, P30, pp3: "Our analysis of the earthquakes in the Raton Basin since 2001 indicates that they are nearly all induced by the nearby fluid injection activities."

COMMENT: Exactly which earthquakes in the Raton Basin are not induced? What is the scientific basis for concluding that they are not induced?

S 6.0, P31, pp1: "Thus, as has been observed in other studies of induced earthquakes, it appears that injected wastewater has moved along the target formation, the Dakota sandstone, into an unmapped fault zone and triggered earthquakes by increasing pore pressure (Figure 1)."

COMMENT: There is absolutely no data presented to show how the gravity-fed wells increased pore-pressure in this underpressured basin sufficiently to overcome the normal stresses on faults that have not even been completely mapped. An important issue such as this deserves better from the nation's geological science agency than, "it appears that injected wastewater has moved along the target formation, the Dakota sandstone, into an unmapped fault zone and triggered earthquakes by increasing pore pressure."

CGS Review of USGS Trinidad Earthquakes

Matthews, Vince to: Bill Leith 09/11/2012 09:28 PM

Cc: "Marcia K McNutt", "David Applegate", "Art McGarr", "Bill Ellsworth", Nancy Dorsey, "Ellsworth, Stuart", "Onyskiw, Denise", Philip Dellinger

From: "Matthews, Vince" <Vince.Matthews@state.co.us>

To: "Bill Leith" <wleith@usgs.gov>,

Cc: "Marcia K McNutt" <mcnutt@usgs.gov>, "David Applegate" <applegate@usgs.gov>, "Art McGarr" <mcgarr@usgs.gov>, "Bill Ellsworth" <ellsworth@usgs.gov>, Nancy Dorsey/R6/USEPA/US@EPA, "Ellsworth, Stuart" <Stuart.Ellsworth@state.co.us>, "Onyskiw,

1 attachment

CGS Review of USGS Trinidad.pdf

Bill,
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Vince

Vince

Vince Matthews, Ph.D.

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Saba Tahmassebi, Ph.D., P.E.
Chief Engineer
Land Protection Division
Oklahoma Department of Environmental Quality
707 N. Robinson, P.O. Box 1677
Oklahoma City, OK 73101-1677

Re: Midway Environmental Services
Operating Permit Application (Class I Non-Hazardous)

Dear Dr. Tahmassebi:

We have completed our technical review of the injection well Operating Permit Application for Midway Environmental Services. Several significant concerns were identified and recommendations developed based on this review. In particular, given recent seismic activity in the regional area of the proposed well, we think it is very important that precautions be taken to minimize the potential to induce seismicity. This potential is dependent on a combination of site geology, geophysical and reservoir characteristics; and while no single recommendation addresses all of the complexities related to injection-induced seismicity, we recommend several additions to the permit application to enhance site assessment and contingency planning. In addition to these items, we recommend additional actions to the permit application to address questions about the actual injection interval and area of review (AoR) reliability. Specific comments and recommendations are outlined below.

1. Deficiencies related to the AoR include failure to identify the trajectory of the legs of horizontal wells; and not verifying the effectiveness of past abandoned well plugging techniques for the expected pressure buildup conditions.
2. The geologic characterization of the intervals of interest should be enhanced, particularly with respect to identification of nearby faults and lateral changes in the relevant formations from the overlying confining zone to a lower confining zone. This should include obtaining sufficiently detailed well information, especially actual well logs for all critical wells in the area, and seismic line data if necessary for a definitive fault assessment.
3. Relevant federal regulations 40 CFR 146.13(a)(1) prohibit fracture stimulation of Class I well injection intervals. The fall-off tests show that the top of the injection interval has enhanced near well bore permeability, i.e. a significant negative skin. This may be due to natural fractures or fracturing during drilling operations. No fracture pressure has been derived from actual testing. A conservative estimate for the maximum bottomhole pressure, to prevent fracturing during well operation, would be to apply a minimum fracture gradient estimate to the top injection depth and round down to the closest numerical value ending in zero. For example, 0.5 psi per foot times 4633 ft for a maximum bottomhole injection pressure of 2310 psi. This would then be converted through use if the maximum possible fluid density and appropriate friction calculations for the specific tubulars to a maximum surface injection pressure.

4. Class I non-hazardous wells are not permitted to inject materials with hazardous characteristics. Facility protocols should be effective in ensuring that this will not occur. Though not related to injection regulations, facility safety protocols should be designed to ensure that neither increasing concentrations above a hazardous level nor mixing of incompatible fluids takes place.
5. Given the limited geologic understanding, fall-off test evidence of nearby boundary conditions, and the proximity to an area exhibiting recent seismic activity, the following additional permit requirements are recommended:
    a. Continuous recording of injection rate and pressure, as required under 40 CFR146.13(b)(2). The results should be provided to ODEQ at a pre-defined timing, as both daily averages and plotted in a Hall plot in Excel or a similar spreadsheet.
    b. An annual fluid profile test to verify where the injected fluid is leaving the wellbore. This should be either a temperature survey or a radioactive tracer depending on required clarity of the results.
    c. Set-up and provide continuous monitoring of sufficient seismometers to identify the specific source of any new seismicity in the immediate area. These should be in-place prior to injection. The Oklahoma Geologic Survey geophysical observatory staff will be your best resource for specific details.
6. Create a contingency plan in the permit for required actions to be followed in case seismic activity is identified in the immediate area. These would use threshold events to trigger specific actions, such as the following examples:
    a. Increasing frequency or clusters of small detected seismic events in the area.
        i. Increase monitoring frequency of injection parameters, such as formation pressure and rates, and increase frequency of reporting of the information to ODEQ.
    b. Any events above a pre-defined background level, up to magnitudes felt only in the immediate area.
        i. Increase monitoring of fluid specific gravity, since the density impacts the bottomhole pressure in the well.
    c. Events felt at a greater distance, with no reported damage.
        i. Reduce the injection rate
        ii. Inject intermittently to allow time for pressure dissipation, with the amount of shut-in time needed being site-specific
    d. Events that cause damage
        i. Cease injection

We would be glad to discuss any or all of these comments and recommendations in greater detail. Should you have any questions or concerns contact Philip Dellinger of my staff at, (214) 665-8324 or Omar T. Martinez, at (214) 665-8485, EPA's Program Manager for the Oklahoma Department Environmental Quality.

Sincerely yours,

Stacey B. Dwyer, P.E.
Associate Director
Source Water Protection Branch

cc: Ms. Hillary Young, P.E.
Engineering Manager
Solid Waste Permitting & Underground Injection Control
Land Protection Division, DEQ

6WQ-SG:O.T.MARTINEZ:otm:12/20/12:MIDWAY: U WAT

6WQ-SG	6WQ-SG	6WQ-SG
DORSEY	K.JOHNSON	DELLINGER

Fw: ODEQ draft letter RE: Midway Environmental Services

William Honker to: Sam Coleman 12/20/2012 04:17 PM
Cc: Wren Stenger

From: William Honker/R6/USEPA/US
To: Sam Coleman/R6/USEPA/US@EPA,
Cc: Wren Stenger/R6/USEPA/US@EPA

Sam - fyi, our comment letter to ODEQ on the Class I well with the seismic issue. This final version includes input from OW and USGS.

Bill

Bill Honker, P.E.
Director, Water Quality Protection Division
EPA Region 6 - Dallas, TX
Phone 214-665-7101
Fax 214-665-7373
Cell 214-551-3619

----- Forwarded by William Honker/R6/USEPA/US on 12/20/2012 04:15 PM -----

From: Stacey Dwyer/R6/USEPA/US
To: William Honker/R6/USEPA/US@EPA, Wren Stenger/R6/USEPA/US@EPA
Date: 12/20/2012 01:58 PM
Subject: ODEQ draft letter RE: Midway Environmental Services

Final Letter To ODEQ- Midway Env Ser 12-20-2012.docx

Please take a final look. We have contacted ODEQ, OCC, OGS, USGS, and EPA HQ. No major disagreements on our approach were identified by these agencies based on the language in the letter. If you are OK with the letter, we can send it out today. Otherwise, Phil will sign for me on tomorrow if you have any issues.

Thanks,

Stacey

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- Water Reuse & Oil & Gas
- Class I, II, III, & V Issues
- Induced Seismicity
- RBDMS Data Mining for Oil, Gas, Class II & VI UIC Wells
- Aquifer Exemptions
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Submit abstracts abstracts@gwpc.org by November 15th

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- SARASOTA, FLORIDA

30 years UIC

Hotel and conference registration available soon at www.gwpc.org/events

Ground Water Protection Council
13308 N. MacArthur Blvd.
Oklahoma City, OK 73142
Phone: 405-516-4972
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Preliminary agenda outline… ***Aquifer Management & Underground Injection*** (subject to changes based abstract submittals)

<table>
<tr><td colspan="4">Tuesday, January 22</td></tr>
<tr><td>10:00 -
5:00</td><td>Class I UIC Operator Training
Steve King, Subsurface Technologies

- History of Injection and Overview of UIC Program
- Permitting
- Petitioning
- Siting Criteria, Geology, and Reservoir Properties
- New Class I Well Construction Well Repair and Workovers
- Operating Procedures
- Fluid Quality
- Inspections
- Mechanical Integrity Testing
- Reservoir Testing
This is an interactive course. Questions from the participants are encouraged.</td><td>FracFocus 2.0 Training
(Train the Trainer)

- Updates on progress of 2.0 implementation
- Changes from FF 1.0 to 2.0
- New features of FF 2.0
- The new xml system and why it will be better
- Step by step process for uploading and modifying records
- Demo’s of registration by type, record entry and modification, recalculations of % mass, and state data downloading
- The quick guide, training slides, and how to use them</td><td>Well Integrity Workshop
Dan Arthur, ALL Consulting

This workshop will address issues such as:
- Choosing equipment and testing methods
- QA/QC planning
- Using Standard Procedures for Field Implementation of testing
- Drilling and Completion Program Evaluations
- Assessing annular pressure and pressure trends
- Assessing annular gas vent rates
- Cement evaluation
- Quality Assurance for well integrity tests
- Determining validity of tests performed
- Planning and evaluating the adequacy of cement
- Surface Casing testing
- Intermediate and Production Casing Considerations
- Testing and evaluating various mechanical integrity tests
- Isotopic gas sampling and analysis
- Water sampling and analysis
- Well evaluation methods
- LEL monitoring when gas is being vented
- Safety issues specific to gas venting</td></tr>
<tr><td colspan="4">Wednesday, January 23</td></tr>
<tr><td>8:30-10:00</td><td colspan="3">Aquifer Management & Underground Injection</td></tr>
<tr><td>10:30-
12:00</td><td>Aquifer Storage and Recovery
- Technical
o Minimizing negative aquifer interaction with injectate
o Monitoring &/or modeling beyond point of injection</td><td rowspan="3">Oil & Natural Gas: UIC and Aquifer Management
- Class II UIC
o Evolution of Salt Water Disposal & the Shale Play Revolution
- Water Quality Impacts
o Aquifer Exemptions and Groundwater Cycling
o Stray Gas
- Water Quantity Impacts
o Shale Play Water Management Modeling</td><td rowspan="3">*A Technical Workshop for Seismologists, Regulators, and other Stakeholders:* Assessing and Managing the Risk of Induced Seismicity by Deep Underground Injection</td></tr>
<tr><td>1:30-3:00</td><td>Aquifer Storage and Recovery
- Policy & Regulation
o Point of compliance
o Aquifer Exemptions & ASR
Petition for an Aquifer Exemption at the L-63N (Taylor Creek) ASR System Okeechobee County, Florida</td></tr>
<tr><td>3:30-5:30</td><td>Desalination Concentrate & UIC</td></tr>
</table>

Thursday, January 24			
8:30-10:00	Class I, III, & V UIC Issues & Discussion		Class II UIC Issues & Discussion
10:30-12:00	Class V UIC Issues - Stormwater, Low Impact Development & UIC	State EPA Panel - EPA Hydraulic Fracturing Study - Diesel Guidance - Effluent Limitation Guidelines - Class VI UIC Implementation	RBDMS Environmental: Tracking Pre & Post Fracture Monitoring Data RBDMS Data Mining: Training on downloading up to date information from state RBDMS Web sites on… - Class II wells: active wells, water injected… - Oil and gas wells: permits issued, active wells, production information - Online permitting and reporting - Basin and interstate analysis Pre & Post Drilling/HF Water Quality Data - How to sample - What to sample - Interpretation of results
1:30-3:00	Aquifer Exemptions Round Table - Regulatory challenges - What do we know about the science? - What next?		

GROUNDWATER PROTECTION COUNCIL

The GWPC provides a forum for stakeholder communication and research in order to improve governments' role in the protection and conservation of groundwater.

Ground Water Protection Council

*13308 North MacArthur Boulevard, Oklahoma City, OK 73142 * 405 516 4972 * www.gwpc.org*

Abstract Submittal Information:

Email abstract to abstracts@gwpc.org by *November 15th* in the following format:

TITLE: centered—14 pt—bold—Times Roman
Author Names(s): centered—12 pt—bold—Times Roman
Author(s) Bio: max. 100 words—11 pt—Times Roman
Abstract: max. 300 words—11 pt—Times Roman

Notification will be via email by *November 29th*.

Presentation Information:

- Presentations may be oral with MS Power Point.
- Oral presentations must be no more than 18 minutes, followed by a 2 minute question and answer.
- Full Paper (if applicable) and Abstracts & Bios are due by *January 15th*

(Full paper not required to make oral or poster presentation)

Full Paper Detail: 15 pages total: (11pt – single spaced - Times New Roman)
1 page Abstract & Bio, 14 pages including text, diagrams, photos and/or tables
Page Margins: .75 inches

- Conference handbooks including abstracts & bios will be available to all participants at event.
- Power Point presentations and full papers will be posted on the GWPC conference web site following the event.

For question regarding instructions send e-mail to abstracts@gwpc.org or call 405 516 4972.

Event Registration Information *Now Open*	Hotel Registration Information *Now Open*
Conference Rates:	**Lido Hotel**
Full Conference – Government - $325	700 Ben Franklin Dr., Sarasota, FL 34236
Full Conference – Non-Government - $425	"*Ground Water Protection Council*" Room Block
Full Conference – Presenter Discount Rate - $175	Conference Room Rate: $129: Reservations: 800 441-2113
One Day Rate - $225	*Special Conference rate is good through January 2nd*

For Exhibit and/or Event Sponsorship Opportunities, contact Ben Grunewald at ben@gwpc.org or 405 516 4972

Registration Form – 2013 GWPC UIC Conference – January 22-24

Name:_____

Title: _____

Organization: _____

Address: _____

City/ST/Zip:_____

Phone:(_____) _____Fax: (_____) _____

Email: _____

Registration Fees: ❑ Full Conference: Government - $325 ❑ Full Conference: NON-Government - $425 ❑ One Day - $225 ❑ Presenter - $175 ❑ Comp*

Method of Payment: ❑ Visa/MC ❑ Amex ❑ Discover ❑ Check Enclosed

Credit Card # _____Expires: _____

Signature: _____

Register online at www.gwpc.org
Return registration form by fax: (405) 516-4973
Or mail to: The Ground Water Protection Council, Attn: Brenda Short, 13308 N MacArthur, Oklahoma City, OK 73142
*Pre-approved required

Fw: Invitation to particpate

Susie McKenzie to: Philip Dellinger, Keara Moore 11/09/2012 12:52 PM
Cc: Ken-E Johnson, Brian Graves, Nancy Dorsey, Rob Lawrence

From: Susie McKenzie/R6/USEPA/US
To: Philip Dellinger/R6/USEPA/US@EPA, Keara Moore/DC/USEPA/US@EPA,
Cc: Ken-E Johnson/R6/USEPA/US@EPA, Brian Graves/R6/USEPA/US@EPA, Nancy Dorsey/R6/USEPA/US@EPA, Rob Lawrence/R6/USEPA/US@EPA

1 attachment

13UIC_Promo_CFA11_07.pdf

Phil,
Will we have any travel budget to send someone to the GWPC UIC meeting in FL?

Keara,
I know GWPC would appreciate someone from EPA speaking, so you might want to approach Ann if she planned to send someone from your office.

Thanks,
Susie

Susie Lopez McKenzie, PE
EPA Region 6 (6WQ-SG)
214-665-7198 work
214-686-6056 cell
mckenzie.susie@epa.gov

-----Forwarded by Susie McKenzie/R6/USEPA/US on 11/09/2012 12:48PM -----

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To: Susie McKenzie/R6/USEPA/US@EPA
From: "Ben Grunewald" <ben@gwpc.org>
Date: 11/09/2012 10:43AM
Subject: Invitation to particpate
==========
Hello Susie!

Say, we are beginning to build the agenda for the UIC meeting that will be January 22-24 in Sarasota, FL and would like your help with the induced seismicity session. If you have contact information for the key folks who are working (or have worked) on the studies in Region 6 or elsewhere, we would like to invite them to the event where we will spend the better part of a day on the subject.

Attached and the note below is what we are sending out attempting to solicit abstracts...

THANKS!

Ben Grunewald

405-516-4972

Hello Dr. _____!

We want to let you know the call for abstracts for the Ground Water Protection Council's (GWPC) UIC Conference is open through November 15th. The 2013 event will take place in Sarasota, FL, January 22-24.

The GWPC is the national association of state groundwater regulators. Our member agencies regulate aspects of the oil and gas industry that, among other things, protect groundwater resources associated with industry activities such as underground injection and hydraulic fracturing.

Of particular interest to you is a special one-day session on induced seismicity by injection, specifically, A Technical Workshop for Seismologists, Regulators, and other Stakeholders: Assessing and Managing the Risk of Induced Seismicity by Deep Underground Injection. This session will be Wednesday, January 23rd.

Please consider submitting an abstract. A limited amount of TRAVEL ASSISTANCE is available to presenters of induced seismicity by injection research. Our goal is to bring together representatives of as many of the research initiatives (completed and/or in progress) on the subject as possible, along with state and Federal UIC regulators.

Also, please let others (you know) working on this issue aware of this opportunity.

Thank you for your consideration and please let me know if I can answer any questions.

Ben Grunewald

405-516-4972

www.gwpc.org

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governments' role in the protection and conservation of groundwater.